



PUBLIC PERCEPTIONS OF NBIC TECHNOLOGIES

*Ravtosh Bal*¹

Susan Cozzens²

The paper reports findings from the National Citizens Technology Forum (NCTF) held in March 2008. The National Citizens Technology Forum on NBIC technologies was organized under the leadership of Dr Patrick Hamlett, North Carolina State University. The research was funded by the National Science Foundation (NSF) and the Center for Nanotechnology in Society at Arizona State University (CNS-ASU) (grant # 0531194).³

Introduction

Nanotechnology is a set of technologies used to manipulate matter at the nanoscale, with a nanometer being equivalent to one billionth of a meter. At this scale, particles exhibit different chemical, physical and biological properties. The term NBIC technologies refer to the convergence of nanotechnology, biotechnology, information technology and cognitive sciences. It is at the interface of these technologies that the greatest impact of these technologies will be felt. Nano-bio-info-cogno (NBIC) technologies not only represent unique convergence of technological streams, they also create entirely new capabilities for human control and enhancement. If they are only available to part of the human population because of cost, they hold the potential to exacerbate existing inequalities. The issue of the Nano-Divide becomes particularly acute when the unequally distributed benefits include enhanced human capabilities.

The field of nanotechnology also represents a change in the area of policy-making in science and technology. The controversies surrounding earlier technologies such as genetically modified foods and stem cell research have led to a more “upstream” engagement and participatory mode of policy making in the field of nanotechnology. Consensus conferences are a manifestation of this change for they take into consideration the opinions, values and views of

¹ PhD student in Public Policy, Georgia Institute of Technology & Georgia State University, rbal3@mail.gatech.edu

² Professor of Public Policy School of Public Policy Georgia Institute of Technology, susan.cozzens@pubpolicy.gatech.edu



³ CNS-ASU research, education and outreach activities are supported by the National Science Foundation under cooperative agreement #0531194. Any opinions, findings and conclusions herein are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

the public at the initial stage of development of a technology. The National Citizens Technology Forum aimed at providing a platform for generating “informed, deliberative public” opinion about the use of NBIC technologies for human identity and enhancement. Equity and fairness were important concerns that were articulated during the deliberations and are reflected in the final reports that were produced by the different panels.

This paper looks at the National Citizens Technology Forum held at six different sites and examines how the issues of fairness and equity especially in terms of cost and access to the technology were dealt with. We first locate the role of consensus conferences within the wider debate regarding participatory modes of decision making especially for complex science and technology issues. The concepts of fairness and equity are examined by seeing how they have been defined in debates pertaining to health care. NBIC technologies for human enhancement include procedures for both remediation of existing disabilities as well as of enhancement. The use of NBIC technologies for these purposes falls within the locus of health care. The analysis of the survey data reveals the panelists’ opinions about these ethical issues as well as reveals the change post-deliberation. Lastly, the final reports of all six forums are studied to see the areas of concerns as well as the commonalities across all six sites.

The role of consensus conferences

Consensus conferences based on the model originating in Denmark are viewed as a way to democratize the process of policy making in science and technology and as a means of making these areas more accessible to the public. As the process of technological innovation becomes central to a nation’s economic growth, public support for new technologies and scientific projects becomes increasingly important. Simultaneously, the issues pertaining to science and technology have become more complex. Consensus conferences are one of the methods for a more democratic and participative method of decision making that aims to reconcile these two apparently conflicting trends. The increasing participation of experts in technological decision making raises questions regarding the democratic basis of policies in these areas. Also, such decisions often tend to overlook broader societal and ethical concerns and values. Consensus conferences are a means to overcoming the expert-lay divide for they acknowledge the intellectual capacity of the public to come to the right decision regarding these complex issues. (Eisiendel et al, 2001; Seifert, 2006). The aim of consensus conferences is to ensure that issues are discussed by lay people and the final report represents a consensus view that takes into account the diversity of views and values represented in the panel. Blok (2007) views consensus conferences as “democratizing relations between science, policy and the public”. Utilizing concepts from the sociology of scientific knowledge he analyzes consensus conferences as the negotiation of scientific claims with the latter being contested and interpreted rather than given and authoritative.

Consensus conferences are seen as particularly effective devices of public participation as they allow public participation before agenda-setting by experts thereby allowing transparency. The concept of upstream engagement has been examined by Rogers-Hayden and Pidgeon (2007). Upstream engagement is seen as being effective in dealing with ethical and social issues that often arise after a technology has matured and can influence the applications of a technology. Involving the public early in a technology’s development cycle ensures that these issues are dealt with. It is a means of influencing the trajectory of a technology as well ensuring that polarization of opinions regarding the impact and future path of the technology does not take

place. The underlying conception is that dialogue is important for legitimacy of decision-making. Dialogue can ensure decision-making that is sensitive to the varied ethical concerns of the public. Upstream engagement, therefore, “represents a call for greater reflexivity within science, in which scientists engage with whatever values underlie their work and what values will be reproduced through their work.”(Rogers-Pidgeon and Hayden, 2007, pp 357).

Another argument is that dialogue and public engagement in the process of technology assessment leads to better outcomes. This belief underlies the process of risk analysis. Dialogue is critical to risk framing, risk assessment and management. (Pidgeon and Rogers-Haden, 2007). The framing of risks becomes especially important in the case of emerging technologies where benefits and risks are a large unknown (Macoubrie and Cobb, 2004; Cobb, 2005). The study by Cobb examined how risk perceptions are influenced by the manner in which risks are framed. Studies by Macoubrie and Cobb (2004), Macoubrie (2007) have examined how information affects public attitudes. The first study examined attitudes of the uninformed public, the latter looks at informed general public attitudes. Informed public opinion is seen as stable and more helpful to studying how public opinion about nanotechnology will develop. The study by Macoubrie uses a quasi-experimental design where four scenarios pertaining to several controversial applications including human enhancement were presented to the participants. The results indicate that a significant amount of attitude change took place amongst the participants in a positive direction, mainly from neutral to positive. Despite the fact that the scenarios presented were of controversial applications, the participants felt that the benefits outweighed the risks.

Consensus conferences have also been subject to numerous evaluations. Most of these evaluations have focused on the impact of the conference on citizen learning as well as efficacy. Powell and Kleinmann (2007) focus on how the process of participation in a consensus conference affected the perception of the participants with regard to their participation in nanotechnology issues as well as their motivation to participate in other such mechanisms. Their analysis reveals that consensus conferences empower citizens by allowing them to participate in a meaningful manner in complex technological issues. The deliberative nature of the conferences plays an important role in enhancing the knowledge and motivation of participants. The interaction with the experts is also an important component of the process in building capacity of ordinary citizens.

Equity and fairness

Consensus conferences are also an effective means of taking ethical issues into consideration in the process of decision making. As a mechanism of policy making, consensus conferences are particularly effective for the articulation of the values of the participants. The concepts of equality and fairness are two of the values that play a dominant role in the debates. These concepts have been subject to numerous interpretations and need to be explored further. The concept of equality is often differentiated into formal and substantive equality. Formal equality is defined in terms of merit and neutrality- extraneous issues such as race and gender are viewed as not having any influence on decision making. It is based on the concept of equal treatment or like treatment of like. Substantive equality, on the other hand, is conceived in terms of equality of opportunity and outcomes. In this conception of equality, neutrality may be ignored so as to rectify disadvantages in order to obtain equality of outcomes (Bell, 2004).

The role of these concepts in the deliberations of the National Citizens Technology Forum can be clarified by examining how these issues have played out in the debates regarding equal access to health care. The focus of the NCTF is human enhancement, identity and biology. Medical treatment and procedures form an integral part of the debate. The background materials provide detailed descriptions of the anticipated medical interventions that will be used to enhance the normal functioning and abilities of the human body. Such scenarios automatically create ethical dilemmas in the mind of the readers. Besides the desirability of such changes, the cost and access to these technologies is an important ethical concern. If such enhancements become the norm, they should be available to all as part of the health care system. A common belief is that all citizens should have universal and equitable access to quality health care. Again, there is little consensus over what the concept means. Equality of access has been defined variously as utilization or equal treatment for equal need; access as costs incurred in receiving health care- defined in this way equality of access is all about equality of opportunity; access as maximum attainable consumption; access as forgone utility; and access as equality of choice sets. (Culyer and Wagstaff, 1993).

Oliver and Mossialos,(2004) have outlined the numerous meanings that the principle of equity of access in health care has - equal access to health care for those in equal need of it (those with equal needs have equal opportunities to access health care), equal utilization of health care (those who have equal need for health care make equal use of health care) and equal health outcomes. The authors believe that the first principle is the most appropriate principle of equity as it is specific to health care and does not require discrimination between people who are already ill and respects acceptable reasons for differentials in health care utilization by those in equal need. It refers to a certain minimum specified range and quality of health care services. Macinko and Starfield (2002) define the two major forms of health equity as vertical equity or preferential treatment for those with greater health needs and horizontal equity or equal treatment for equivalent needs.

Goddard and Smith (2001) also focus on equity in the form of equal access to health care for people in equal need, stressing that it is important to recognize that this is not necessarily the same thing as equality of treatment or equality of health outcome. They see equity of access as a supply side consideration- equal service for patients in equal need. However, supply and demand interact to create variations in treatment. Thus, the latter depend on the preferences and perceptions of both patient and health care provider. Variations in health outcome are, therefore, dependent on numerous other factors in addition to the receipt of health care. As Culyer (2001) has pointed out, "plainly there is no single theory, universal theory of equity, but it is widely agreed that equity implies equality. Unfortunately, there is no accord concerning what should be equal. The absence of an agreed theory arises out of the absence of a general or monist theory of morality." (Culyer, 2001, pp 275). Whitehead (1992) in his article explores the concepts and principles of equity as understood in the context of the World Health Organization's Health for All policy. The WHO defined inequity as "differences (in health status), which are unnecessary and avoidable, but in addition, are considered unfair and unjust." Out of the numerous causes of health differentials between groups or individuals, those that pertain to genetic variations and voluntary behavior that damages health cannot be considered inequitable because they are either unavoidable or "fair". Equity in health "is concerned with creating equal opportunities for health, and with bringing health differentials down to the lowest levels possible."

Similarly, the concept of fairness too has been defined and assessed in numerous ways.

Whitehead (1992) proposes that criteria for assessing which health inequalities are unfair should include whether they are due to inherent genetic variation; due to informed, conscious individual choices; or are potentially avoidable. Equity and fairness in health is valued by all societies but the magnitude differs by the group studied. As such, it is difficult to assess fairness objectively without imposing some value judgment.

The lack of agreement over the definition of equitable access and fairness in health care debates stems from the more fundamental disagreement over questions of distributive justice (Daniels, 1982). Caplan, White and Daniels (1999) believe that one of the prime reasons issues such as fairness are often relegated to the background in debates on health care is the difficulty in defining fairness. Another major reason is that mainstream economics is disconnected from political philosophy and lacks the necessary concepts for such discourse. The authors arrange the concept of fairness into ten benchmarks, with 30 specific criteria, that can be used to evaluate the fairness of policy alternatives. In a sense, the adoption of these benchmarks may enable one to evaluate fairness in an objective manner. The authors focus on fairness because it is an important concept if the public is to understand what is ethically at stake when health care reform is debated. And it is the missing factor in these debates and policy decisions. The authors' definition of fairness is based on "equalizing people's opportunities to participate in and enjoy life, given their circumstances and capacities". (Caplan, White and Daniels, 1999, pp 856). Disease and ill-health limit access to these opportunities while health care protects or increases these opportunities. The former creates arbitrary and remedial differences that should not affect an individual's opportunities to enjoy life. The concept of fair equality of opportunity acknowledges this. The other benchmarks draw on other aspects of fairness, such as the need to create a "level playing field", ability to pay or financing of the services, and the degree of consumer choice. In the view of the authors, these benchmarks act as a moral framework for the health care system that takes into account values such as fairness.

Lessons learnt

The introduction of more participatory methods of policy making in the field of nanotechnology can be traced to the controversies surrounding biotechnology and nuclear energy. Mehta (2004) has argued that failure to consult the public frequently as well as early in the stage of development of a technology can lead to complexities while regulating the technology. Einsiedel and Goldenberg (2004) also point out that the major lesson to be "learnt from the evolutionary path of biotechnology is the danger of keeping the social at bay when developing or discussing technology". Inviting different perspectives to the debate about a technology's development allows for the technology to be sustainable. Rogers-Hayden and Pidgeon (2007) point out that nanotechnology provides an opportunity for "upstream engagement"- public participation in the early stages of the technology before significant research and development has taken place. Upstream engagement does not involve merely asking the same question at an earlier stage but the formulation of new questions and discussion about the values and vision of the future. Successful upstream engagement requires that it be "future focused, broadly framed, and incorporate questions about both public values and technology governance". Doubleday (2007) emphasizes that the litmus test for determining whether lessons have been learnt from the controversy regarding GM foods is the manner in which science policy handles the public dimension of Nanotechnology. Doubleday reviewed six public engagement projects on nanotechnology during 2005 and 2006. Four of these occurred in UK while the other two took place in the US. His analysis reveals that the current framing of the

issue directs attention away from the governance of innovation to narrower concerns of risks associated with nanoparticles. Though the scope of debate has been broadened in terms of the number of actors, it has considerably narrowed in terms of the range of questions being asked. Public deliberation rather than bogged down by such narrow concerns should focus on the broader concern which is the social management of science and innovation.

The National Citizens Technology Forum on human identity and enhancement does indeed envisage such a broad role for its participants. The goals of the project were to:

“1. Generate *informed, deliberative public opinion* about how to manage the technologies of human enhancement for elected officials, government policy makers, business leaders, etc., who will be making the important decisions about these technologies.

2. Demonstrate that average, non-expert citizens can understand even quite complex issues and, if they have adequate information, they can come to sensible, informed judgments about those issues

3. Provide information to other concerned citizens about techniques like this one that can enhance the abilities of ordinary citizens to help shape public policy on important issues.”

The NCTF Process

The NCTF is modeled on the Danish Consensus Conferences. The research is funded by the National Science Foundation grant through the Center for Nanotechnology and Society at Arizona State University. The consensus conferences in Denmark are organized by the Board of Technology that is a part of the Parliament on a specific request for informed citizen input on a science and technology policy issue. The National Citizens Technology Forum on NBIC technologies for human identity and enhancement was organized on six sites across the country in the month of March 2008. The six sites were the Arizona State University, University of California at Berkley, Colorado School of Mines, Georgia Institute of Technology, University of New Hampshire, and University of Wisconsin-Madison. Each of the Citizens Technology Forum operated independently though they had access to the same experts, read the same background materials, and were part of the same team during the internet sessions. The background materials were prepared keeping in mind that they had to be “accurate, balanced, and accessible to ordinary people”. The material was prepared by the team at North Carolina State University with input from the other five teams. The background material was also scrutinized by an oversight committee consisting of experts on nanotechnology to ensure its accuracy.

The forum was a combination of face-to-face sessions and interactive internet sessions or K2K (keyboard to keyboard) sessions that were facilitated by North Carolina State University. The former were held over the first and last weekend of March and were interspersed with seven internet sessions. The internet sessions were a series of two-hour, synchronous, on-line sessions. During these sessions, the panelists from all six sites work together to complete a number of specific tasks, interacted with the other teams across the country and learnt about their views and

concerns. A panel of five content experts was also available during these sessions to answer queries. Internet sessions are not part of the original Danish format. The internet was first used as part of a consensus conference during a research project at North Carolina State University in 2001. Two conferences on genetically modified foods were held at the same time-one using the traditional face-to-face format and the second used the internet for deliberations. A paper by Hamlett (2002) reviews these two conferences and concludes that the internet can be successfully used for public deliberation. In fact, the study concludes that a format that utilizes both face-to-face deliberation and internet sessions would be ideal for public deliberation. This is the format adopted by the National Citizens Technology Forum under the leadership of Patrick Hamlett.

The participants for the forum were recruited through advertisements in local newspapers asking for volunteers. Those who responded to the advertisement were asked to fill a short questionnaire that had information regarding socio-economic characteristics such as age, gender, race, income etc. The questionnaire also asked whether they or any of their close family members were employed in any business employing nanotechnology, had significant investments in such businesses, or were members of an advocacy group that had a strong position on the technology. An answer of "yes" disqualified the respondent as the aim was to have a panel that represented the lay public. A stratified sample was then drawn from the pool of respondents that was representative of the community. The participants were compensated for their time and participation. A total of 72 participants spread across the six sites finally participated in the NCTF.

The final report of each forum consisting of a set of recommendations was written over the final weekend during the face to face session. The panelists worked with a facilitator so all concerns could be addressed and opinions considered. The report was a consensus report- the participants were not expected to have a unanimous opinion about the issues but the recommendations were expected to address each panelist's concerns and reflect their values so that each panelist can endorse the report. "The most basic goal of the Citizens Technology Forum (CTF) process is to create a structured, organized, and well executed process through which ordinary, non-expert citizens can generate thoughtful, informed, and deliberative recommendations for managing technology." The aim of the process also was not for all the six panels to reach a consensus but areas where recommendations overlap will represent "a national, informed, deliberative public opinion."

Survey Data

The panelists were administered a pre-and post-test survey. The survey questions addressed a number of issues from knowledge of the technology to perception of the risks and benefits. The survey also included questions pertaining to cost of the technologies and equity of access.

A number of writers have examined risk perceptions by focusing on the framing of the issue and the opinions of the public regarding nanotechnology and its applications using survey data. Cobb's study (2007) reveals that the framing of risk plays an important role in the manner in which the public perceives risk. Frames about the specific benefits and risks of nanotechnology have a greater impact than frames that employ general beliefs such as the merits of science. Priest (2006) in her study utilizes a January 2005 telephone survey of 1200 people in

the U.S. and 2000 Canadians to provide an idea of North American opinion regarding nanotechnology. Her analysis reveals that differences in public opinion regarding nanotechnology are related not only to general attitudes towards technology but also the perceived compatibility between the technology and the values of individuals'. If people believe that nanotechnology development serves their interests and is in accordance with their value systems, they will support it.

The importance of scientific knowledge as well as the sources of information regarding the technology has an impact on risk perception. Scheufele and Levenstein (2005) also utilized findings from a national telephone survey on levels of knowledge about and attitudes toward nanotechnology that demonstrate how people make decisions about emerging technologies. Their analysis shows that "cognitive shortcuts", such as those provided by mass media, are an important factor in influencing how the public thinks about nanotechnology and its risks and benefits as well as in determining the level of support among the public for further funding for research in this area.

The survey administered to the NCTF participants' included questions on cost and access. The change in opinions from pre-deliberation to post-deliberation can be analyzed using the pre- and post-survey data. Regarding the importance of the issue of human enhancement, 56% of the panelists felt that the issue was somewhat important while 34% felt that the issue was very important. Post deliberation these figures changed to 53% and 21% respectively. Table 1 shows the change post deliberation on opinions pertaining to cost and access to the technology for human enhancement. The survey had a number of questions that covered issues such as extent of content knowledge, the perception of risks and benefits, trust, and ethical issues such as equity and fairness. The data pertaining to questions about the latter are shown in the table below.

Table 1

	Pre Deliberation	Post Deliberation
The issue of human enhancement is "very important"	34%	21%
The benefits of using nanotechnology for human enhancement will "very certainly" exceed risks	8 %	14%
Human enhancements based on these technologies will be too costly for the average American when brought into the market	55%	56%
The government should guarantee equal access to human enhancements if they are too expensive	56%	64%
Medical insurers should pay for human enhancement	40%	38%
"Very worried" that the average person will not be able to afford this technology	12%	8%
"Very worried" that you and your family cannot afford these enhancements	21%	22%

The replies to the last two questions in the table regarding the affordability of the technology provide an insight to the panelists' perceptions about fairness in terms of cost and access to the technology. A breakdown of the responses in terms of socio-economic characteristics gives a better understanding of these perceptions. The data regarding the opinions of the panelists pertaining to the average person being able to afford human enhancement reveals

that more women were “very worried” as compared to men. Pre-deliberation, 16% of the women were “very worried” as compared to 7% of the men. Post-deliberation, these numbers declined to 11% and 6% respectively. With regard to the opinions of the panelists about whether they or their family can afford these enhancements, 16% of the men were “very worried” while 26% of the women were “very worried”. These numbers increased to 17% and 27% respectively, after the deliberations.

Looking at the association of cost with income levels of the participants; 14% of those who earned >75,000 per annum were “very worried” about the ability of the average American to afford these enhancements as compared to 12% of those who earn less than 35,000 per annum. These figures changed to 28% and 15% respectively, post deliberation. In comparison, 10% of those who earned >75,000 per annum and 8% of those who earned less than 35,000 per annum were “very worried” about their and their family’s ability to pay for these enhancements. These figures increased to 21% and 23% respectively, post deliberation.

With reference to the education level of the participants, 16% of those who had completed high school but did not have a college degree were “very worried” that the average person will not be able to afford these enhancements while 9% of those who had a college degree were “very worried”. These numbers changed to 25% and 19% respectively after deliberations. In comparison, 6% of those who had completed high school but did not have a college degree were “very worried” that they and their family will not be able to afford these enhancements while 7% of those who had a college degree were “very worried”. These numbers increased to 28% and 13% respectively, post deliberation.

The figures reveal that the participants were more worried about their and their family’s ability to afford these enhancements as compared to the average person’s ability. Also, the figures increased for all categories post deliberation. However, the concern about affordability did not mean that there was a decline in the percentage of participants who felt that individuals should pay for these enhancements from their own pocket. Pre-deliberation, 40% of the panelists said that medical insurers should pay for enhancements and 47% answered don’t know. After deliberations, these figures changed to 38% and 30% respectively. From 14% believing that individuals should pay for these enhancements from their own pocket, the number increased to 32% after deliberations.

Final Reports

The final reports had much in common- the differences were minute in comparison. A matrix⁴ of the six final reports shows that there were eleven areas of concern regarding which specific recommendations were made in the different reports- regulatory adequacy, public information, access/equity, funding accountability, safety, entrepreneurship and development, ethical considerations, privacy, health insurance, military uses, environment impacts, and rights. With regard to access and equity, five of the six reports made specific recommendations. The CTF at Arizona State University recommended that all especially minority groups should have equitable access; discrimination with regard to adoption of NBIC should be avoided, and panelists were concerned that benefits may be only for a reserved few. The CTF at California examined the issue of equity with reference to testing. Their concerns were that there should not be any discrimination when it comes to the testing of these technologies. Also, testing ought to

⁴ Cobb, M and P.Hamlett (2008). “The first national citizens’ technology forum on converging technologies and human enhancement: adapting the Danish consensus conference in the USA.” Paper presented at the 10th Conference on Public Communication of Science and Technology, Malmö Sweden, Jun 25-27, 2008.

be done only on the willing and it should be accompanied by community notice so that all are informed. The citizen forum at Colorado recommended that everyone deserves equal access and the technologies should be available to those who need it the most. In Georgia, the panelists were concerned about the impact of these technologies on the health care system. They recommended that a new healthcare system may be needed to overcome inequalities. With regard to the applications, they favored reparative application over enhancements. The panelists were also concerned that NBIC should promote diversity. The team at New Hampshire recommended that access should be guaranteed to the “most needful”.

There were common threads pertaining to concepts of fairness and equity across all teams. Accessibility and equity were important concerns. Panelists were also concerned about the exercise of free will by the public. The decision to undergo enhancement should arise from choice rather than be imposed on people. There were concerns during the deliberations that the availability of technology to enhance humans coupled with the high cost of such technology would increase the existing stratification in society. It may also lead to the creation of a new under-class of the “unenanced”. The technology may also necessitate changes in the legal set-up to protect against discrimination of those who do not opt for such procedures. Testing on humans was also an important concern of the participants. Not only should the procedure be fair based on voluntary participation but care will have to be taken that minorities are not ignored during clinical trials so that the effects can be studied for all the population.

Conclusion

The National Citizens Technology Forum was effective in generating “informed, deliberative public” opinion about the use of NBIC technologies for human identity and enhancement. The final report of all six panels represents a consensus view that takes into account the diversity of views and values of the panelists. The commonality amongst the reports also suggests that the issues of equity and fairness were equally important at all the sites. The deliberation of ordinary citizens in the form of a consensus conference does enable the articulation of broader societal and ethical concerns and is an important device for the social management and science and innovation.

REFERENCES

1. Anderson, A., Allan, S; et al (2005). "The Framing of Nanotechnologies in the British Newspaper Press." Science Communication 27(2): 200-220.
2. Andersen, Ida-Elisabeth and Brigit Jaeger (1999)."Scenario Workshops and Consensus Conferences: towards more democratic decision-making". Science and Public Policy. 26(5):331-340.
3. Bell, Mark. (2004). "The concept of equality."Paper presented at the seminar "Fight against Discrimination: the race and Framework Employment Directives", Trier, 1-2 October 2004. Downloaded from www.era.int/web/en/resources/5_2341_896_file_en.1171.pdf
4. Blok, A. (2007). "Experts on public trial: on democratizing expertise through a Danish consensus conference." Public Understanding of Science 16(2): 163-182.
5. Cobb, M. D. (2005). "Framing effects on public opinion about nanotechnology." Science Communication 27(2): 221-239.
6. Cobb, M. D. and J. Macoubrie (2004). "Public perceptions about nanotechnology: Risks, benefits and trust." Journal of Nanoparticle Research 6(4): 395-405.
7. Culyer, Anthony J (2001). "Economics and ethics in health care". Journal of Medical Ethics. 27(4): 217-22.
8. Culyer, Anthony J. (2001). "Equity--some theory and its policy implications". Journal of Medical Ethics. 27(4): 275-83.
9. Culyer, Anthony J and Adam Wagstaff(1993). "Equity and Equality in Health and Health Care". Journal of Health Economics.12:431-457.
10. Daniels, N. (1982). "Equity of Access to Health Care: Some Conceptual and Ethical Issues." The Milbank Memorial Fund Quarterly. Health and Society 60(1): 51-81.
11. Doubleday, R. (2007). "Risk, public engagement and reflexivity: Alternative framings of the public dimensions of nanotechnology." Health Risk & Society 9(2): 211-227.
12. Einsiedel, Edna F. and Linda Goldenberg. (2004). "Dwarfing the Social? Nanotechnology Lessons from the Biotechnology Front." Bulletin of Science, Technology and Society 24(1): 28-33.
13. Einsiedel, E. F., E. Jelsoe, et al. (2001). "Publics at the technology table: The consensus conference in Denmark, Canada, and Australia." Public Understanding of Science 10(1): 83-98.
14. Goddard, Maria and Peter Smith.(2001). "Equity of access to health care services: theory and evidence from the UK." Social Science and Medicine. 53: 1149-1162.
15. Hamlett, Patrick. (2002). "Adapting the internet to citizens' deliberations: lessons learned." Technology and Society 2002 (ISTAS'02) International Symposium on Social Implications of Information and Communication Technology. Proceedings.Pp213-318.
16. Lowndes, Stephens F. (2005). "News Narratives about Nano S&T in Major U.S. and Non-U.S. Newspapers." Science Communication 27(2): 175-199.
17. Macoubrie, J. (2006). "Nanotechnology: public concerns, reasoning and trust in government." Public Understanding of Science 15(2): 221-241.
18. Macinko, James A and Barbara Starfield. 2002."Annotated Bibliography on Equity in Health, 1980-2001".International Journal of Equity in Health.1:1.
19. Mehta, Michael D. (2004). "From Biotechnology to Nanotechnology: What can we learn from Earlier Technologies?" Bulletin of Science, Technology and Society 24(1): 34-39.
20. Oliver, Adam and Elias Mossialos (2004). "Equity of Access to Health Care: Outlining the Foundations for Action". Journal of Epidemiology and Health Care.58 : 655-658.

21. Powell, M. and D. Lee Kleinman (2008). "Building citizen capacities for participation in nanotechnology decision-making: the democratic virtues of the consensus Conference model." Public Understanding of Science **17**(3): 329-348.
22. Priest, S. (2006). "The North American opinion climate for nanotechnology and its products: Opportunities and challenges." Journal of Nanoparticle Research **8**(5): 563-568.
23. Rogers-Hayden, T. and N. Pidgeon (2007). "Moving engagement "upstream"? Nanotechnologies and the Royal Society and Royal Academy of Engineering's inquiry." Public Understanding of Science **16**(3): 345-364.
24. Scheufele, D. A. and B. V. Lewenstein (2005). "The public and nanotechnology: How citizens make sense of emerging technologies." Journal of Nanoparticle Research **7**(6): 659-667.
25. Seifert, F. (2006). "Local steps in an international career: a Danish-style consensus conference in Austria." Public Understanding of Science **15**(1): 73-88.
26. Waldron, A, Douglas Spencer and Carl A Batt (2005). "The Current State of Public Understanding of Nanotechnology." Journal of Nanoparticle Research **7**(6).
27. Wilkinso , Clare et al (2007). "From Uncertainty to Risk? Scientists and News Media Portrayal of Nanoparticle Safety." Health, Risk, and Society **9**(2):145-157.
28. Whitehead, M. (1992). "The concepts and principles of equity and health". International Journal of Health Services. **22**(3): 429-45.